# Creation of safe and secure society
## Preparing for catastrophic natural disasters

**KAWATA Yoshiaki**
Fellow Member
Dr. of Eng.
Prof. of Kyoto University
Director of the Disaster Prevention Research Institute, Kyoto University
Executive Director of the Disaster Reduction and Human Renovation Institution (serves concurrently)

Following the Sumatra Earthquake of 2004, researchers in both Japan and the U.S. have become concerned about the possible occurrence of the huge earthquakes shown in Figure 1. Because the Sumatra event caused reverberations around the entire globe, delicately balanced plate boundaries and active faults probably became unstable. What if that kind of earthquake hits Japan? The assumed damage and mitigation strategies for the damage are introduced below.

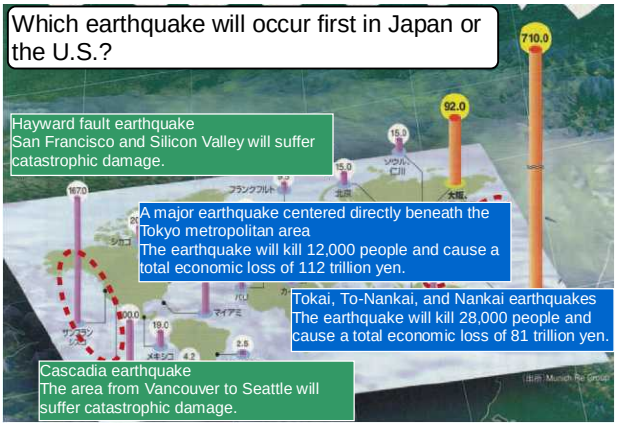


Figure 1 Danger of plate boundary earthquakes and inland earthquakes in Japan and the U.S. (plotted on the world seismic risk map of Munich Reinsurance Company)

### Catastrophic urban and wide-area disasters

The Hanshin-Awaji Earthquake and Niigata Prefecture Chuetsu Earthquake revealed that both urban and mountainous areas are vulnerable to earthquakes, respectively. The people of Japan lead their lives on a fragile archipelago. Concern is rising over the possible occurrence of the following earthquakes: a major earthquake centered directly beneath the Tokyo metropolitan area and the Tokai, To-Nankai, and Nankai earthquakes. The probabilities that these earthquakes will occur in the three decades ahead are 70%, 86%, 60%, and 50%, respectively. It is considered quite likely that these earthquakes will occur by the middle of this century.

**Mixed damage modes across time and space**

Causes:

- A major earthquake centered directly beneath the Tokyo metropolitan area will cause three different and intricately linked types of damage to the metropolis: damage to urban areas still under infrastructural development, damage to lifelines in urban areas, and damage to urban areas with replete infrastructure.
- It will be impossible to cope with the disaster uniformly in time and space.
- There will be a mixture of nine damage modes across time and space.

| | Unable to respond | Delay in response | Appropriate response |
|---|---|---|---|
| Disaster causing damage to urban areas with replete infrastructure | Catastrophic damage | Heavy damage (wide area and prolonged) | Can estimate using predicted values |
| Disaster causing damage to lifelines in urban areas | Disturbance in urban functions (basic existence) | Disruption of economy and people's lives | Minimum damage |
| Disaster causing damage to urban areas under infrastructural development | Damage determined by external forces | Delay in recovery and restoration | Alleviation of human suffering |

Figure 2 Features of damage caused by major earthquake centered directly beneath the Tokyo metropolitan area

A major earthquake centered directly beneath the Tokyo metropolitan area will, if it occurs, be the first catastrophic urban disaster to affect the

modern world. It will cause three different types of damage to the metropolis: damage to urban areas still under infrastructural development, damage to lifelines in urban areas, and damage to urban areas with replete infrastructure, as shown in Figure 2. Of the assumed 18 types of earthquake, if either the earthquake (M7.3) centered at the northern extremity of Tokyo Bay (and having the highest probability of occurrence and with the prospect of causing the heaviest damage) or the earthquake (M6.9) centered in western Tokyo (capable of the highest death tall) occurs, it will kill 12,000 people, completely destroy or burn down about 850,000 houses (650,000 burned down), prevent 6.5 million people returning home and generate 7 million refugees, 4.6 million of whom will have to live in evacuation centers. Economic losses will be 112 trillion yen.

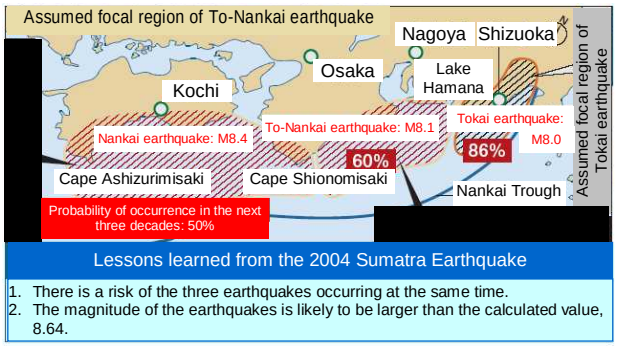


Figure 3 Assumed focal regions and probabilities of occurrence in the next three decades of Tokai, To-Nankai, and Nankai earthquakes as well as lessons learned from the Sumatra Earthquake

The Tokai, To-Nankai, and Nankai earthquakes, if they occur, will be catastrophic wide-area disasters that cut off road and rail traffic. They would isolate victims and prevent disaster information and relief activities getting through, not only in municipalities along the Pacific coast but also in mountain villages of mountainous western Japan, as shown in Figure 3. Outages of lifeline utilities, including power, are likely to be prolonged. If these earthquakes were to occur at the same time, they would kill 28,000, completely destroy 1,110,000 houses, cause economic losses of 81 trillion yen, and affect a total population of 50 million in the earthquake-devastated region.

**Economic damage could destroy Japan**

The anticipated damage caused by a major earthquake centered directly beneath the Tokyo metropolitan area is simply a calculation from a possible damage scenario. This means that damage not predictable from the scenario is not assessed. Even members of the Expert Committee on Major Earthquake Centered Directly Beneath The Tokyo Metropolitan Area at the Central Disaster Prevention Council are unable to simulate the processes of damage, let alone visualize 6.5 million people unable to return home and 4.6 million living in evacuation centers, for example. As one of those members, I'm very concerned about the situation.

The news that an earthquake has hit Tokyo will cross the world in an instant. This may trigger massive sell-offs of the yen and Japanese stocks on the foreign markets; this can be done easily using e-commerce software. As a result, the damage figures mentioned above may explode by a factor of 10. The personal financial assets of the Japanese total 1,200 trillion yen but the national debt, including government bonds, stands at about 782 trillion yen. The balance is only about 420 trillion yen. This is insufficient to rebuild a devastated nation. For comparison, the Meiji government of the time needed to spend one and a half times the then annual national budget to suppress the Seinan War in 1877 (the 10th year of the Meiji era). As a result, measures to develop the Tohoku District and encourage new industries were blocked. The Great Kanto Earthquake had a similar huge impact throughout the country. In such a situation, there is no choice but to adopt a recovery and restoration policy of giving the highest priority to

taxpayers. There is risk of sinking into a financial condition that precludes the adoption of measures friendly to the socially needy in a time of disaster.

**Disaster mitigation strategic plan based on New Public Management**

The policies implemented by the UK's Thatcher Administration in the 1980s led to successful structural reform in the Anglo-Saxon countries and such policies have begun at long last to be adopted in Japan. Based on the idea of maximizing the customer's, or in this case the resident's, satisfaction with administrative services, these New Public Management (NPM) policies center on four points: (1) customer-orientation; regard residents and taxpayers as customers, (2) result-orientation; assess achievement and feed the results back in the form of business improvements, (3) market-orientation; adopt the advantages of private business management, and (4) decentralization of power; hand over power to field staff. Naturally, these policies also affect disaster prevention projects. It is no exaggeration to state that the traditional disaster prevention measures up to the time of the Hanshin-Awaji Earthquake were of the response-to-damage type; measures were taken to ensure the same damage did not occur again. However, with the Sumatra Earthquake and the 2001 terrorist attack on the World Trade Center as a turning point, plans were made for the introduction of a standard crisis management system involving central and local governments and the Geographical Information System (GIS) for disaster prevention and the adoption of an Incident Command System (ICS). The environment for realization of these systems is being improved. Disaster mitigation strategic plan enhances the effectiveness of these systems by implementing the systems in an efficient manner. The plan consists of four elements: objective, goal to be achieved, strategy, and action plan, as shown in Figure 4. Based on this plan, the Central Disaster Prevention Council approved in July this year the goal of mitigating the damage likely to result from the Tokai, To-Nankai, and Nankai earthquakes by half in the decade ahead.